# NPS MDP Study
# Outbrief Schedule, 1 JUN 2005

**0800-0815** Introductions

**0815-0915** Background/Results

**0930-1015** Cargo Inspection System (Land)

**1030-1130** Cargo Inspection System (Sea)

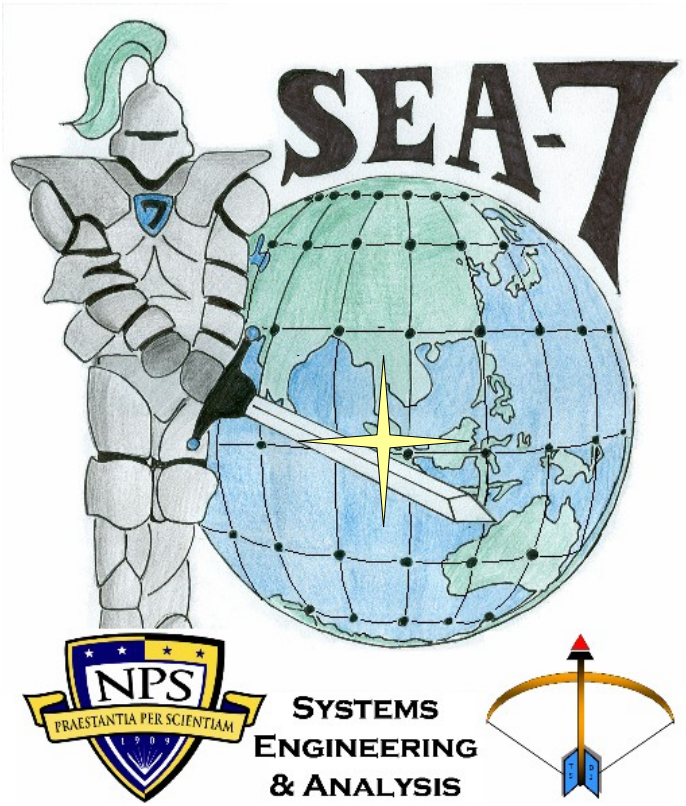
**1130-1230** **LUNCH**

**1230-1330** Sensor System

**1345-1445** C3I System

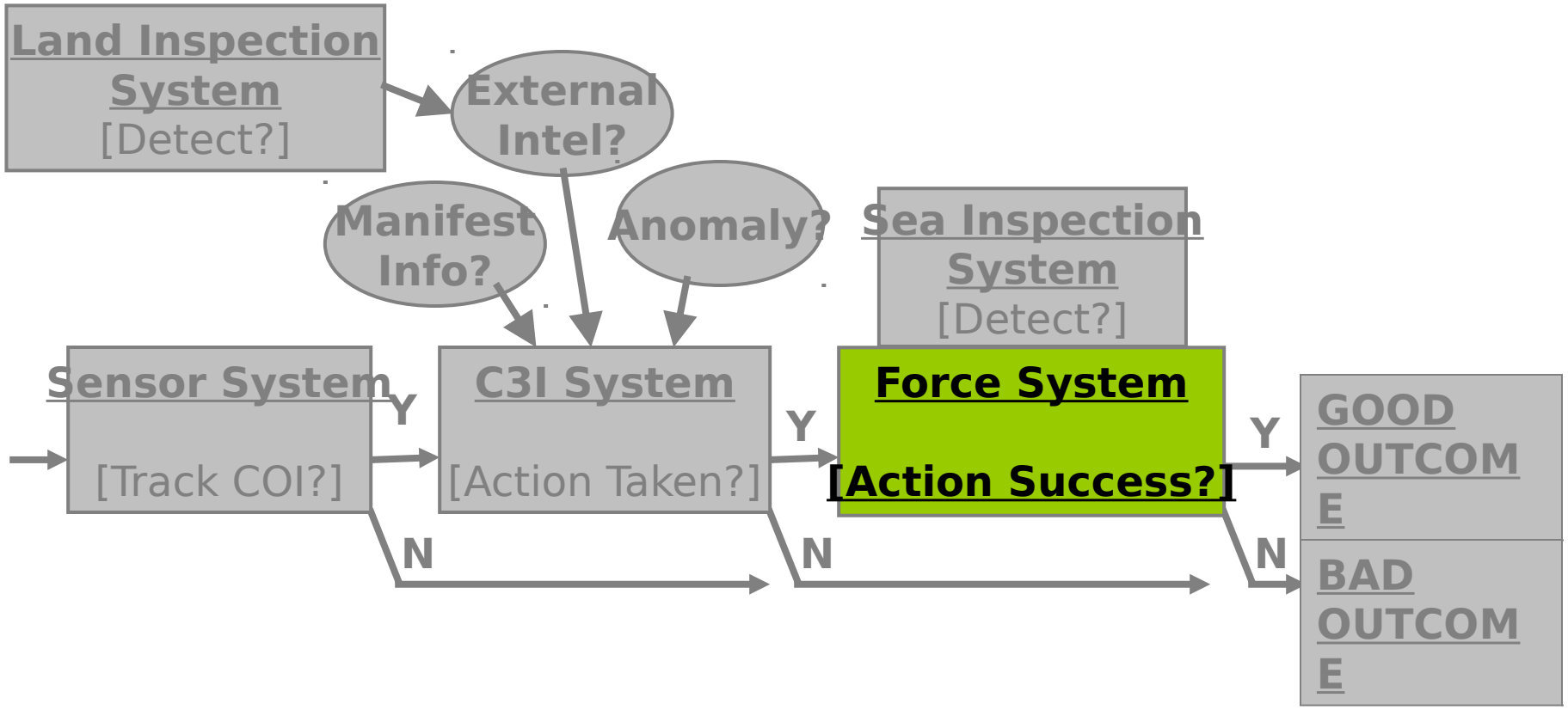
**1450-1600** Response Force System

# Force System




**LT David Walton, USN**

# Force Group


Land Inspection System
[Detect?]
External Intel?
Manifest Info?
Anomaly?
Sea Inspection System
[Detect?]
Sensor System
[Track COI?]
C3I System
[Action Taken?]
Force System
[Action Success?]
GOOD OUTCOME
BAD OUTCOME
Y
Y
Y
N
N
N

# Force Agenda

- Big Picture
- Functional Decomposition
- Requirements
- Alternatives Generation Matrix
- Parameters/Variables
- Model Overview
- Results
- Conclusions/Insights

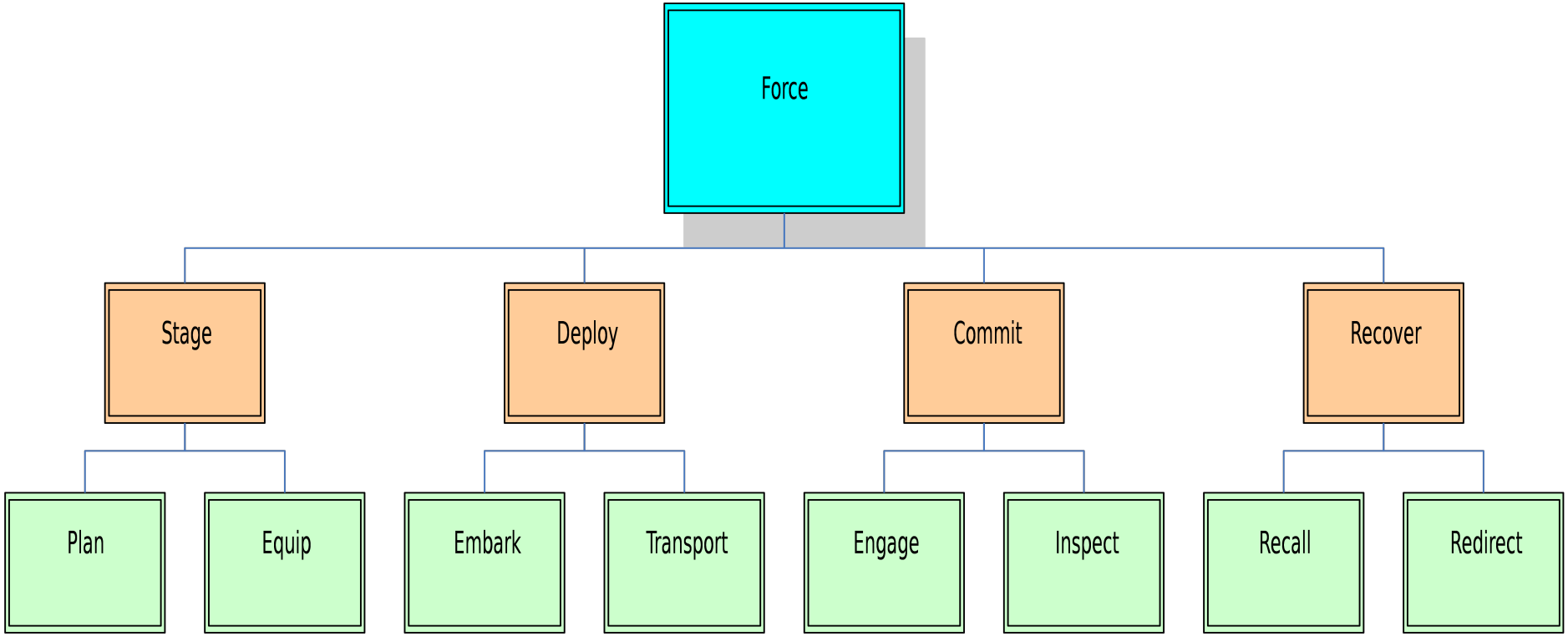
# Force System Objectives

- Engage and defeat physical threats to shipping in the Straits of Malacca
- Identify methods to improve transiting vessel security
- Develop model for force system.
- Recommend system alternatives to improve force performance.

# Force Requirements

| | |
|---|---|
| Small Boat Attack | Keep Small Boat Attack >35m from HVU |
| | Engage and Defeat 80% of SBA threats |
| | Maintain responsive capabilities up to Sea State 3 |
| Ship As Weapon | Keep SAW >250m from pier |
| | Engage SAW by 2,000m from pier |
| | Engage and Defeat 90% of SAW |
| WMD | Transport and utilize inspection gear |
| | Provide security for Inspection Teams during Inspection |

# Force Functional Decomposition



# “As-Is” Force System

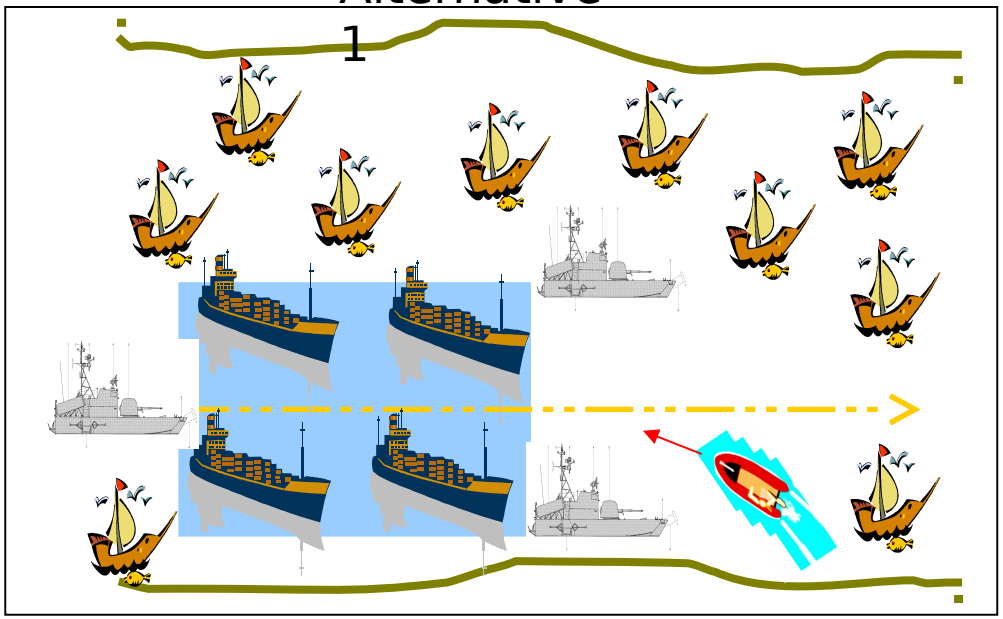
- SBA
  - No persistent regulated force in place
- SAW
  - 3 Man Sea Marshal teams onboard all HVUs entering Singapore ports
- WMD
  - No system in place to inspect incoming vessels at sea

# Force Alternatives Generation

| DESIGN NAME | SBA | | SAW | | WMD | |
|---|---|---|---|---|---|---|
| | Platform | Force | Platform | Force | Platform | Force |
| As-Is | None | None | Harbor Pilot Boat | Singapore Navy Sea Marshals (3) | None | None |
| Patrolling | Weapons Transport | Transport Crew | Weapons Transport | Singapore Navy Sea Marshals (3) And Weapons Transport Crew | Helicopter | Inspection Team |
| Sea Marshal | HVU | Sea Marshals (5) | Helicopter | Singapore Navy STAR Team (12) | Weapons Transport | Inspection Team |

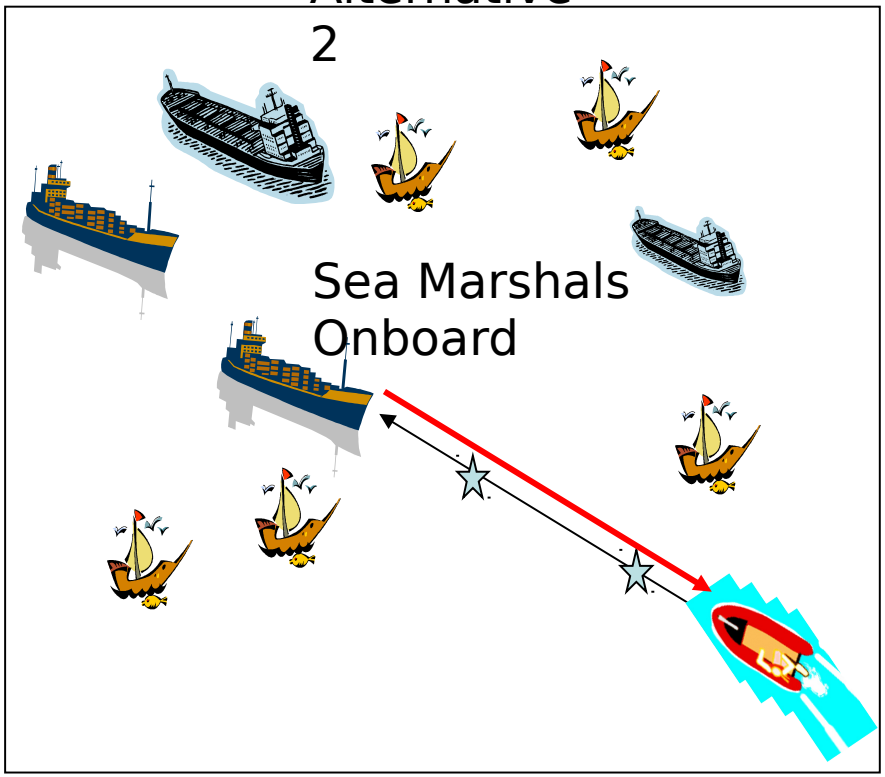
# Force SBA Scenario Alternatives

Alternative 1



- Patrol/Escort of HVUs through AOR
- 3 Escorts per 150nm operational area

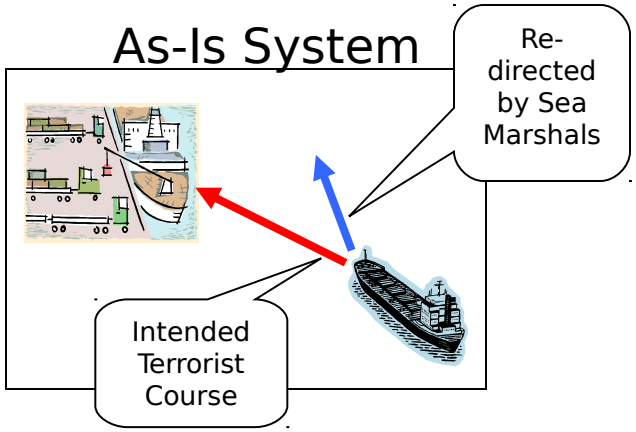
Alternative 2




- Onboard Sea Marshal Teams
- 5 Man Teams (2 crew-served weapons)

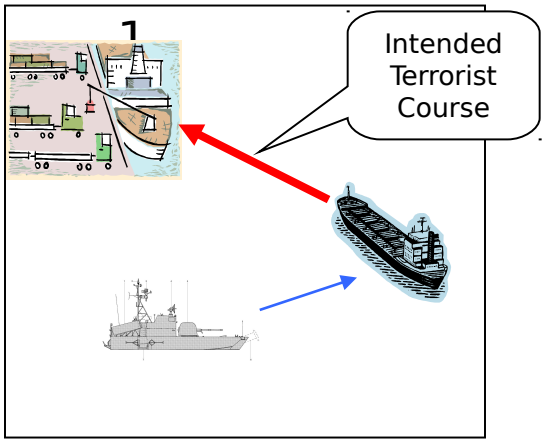
# Force SAW Scenario Alternatives

As-Is System



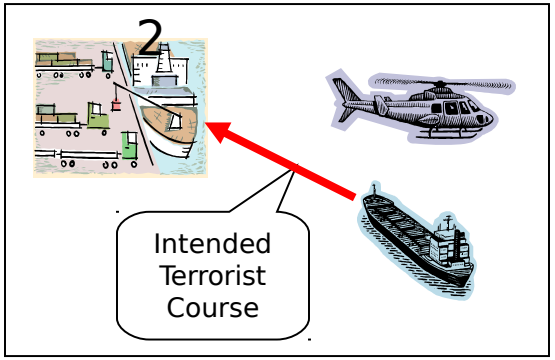

- 3 Man Sea Marshal Team

Alternative 1




- 3 Man Sea Marshal Team
- Sparviero Patrol Craft

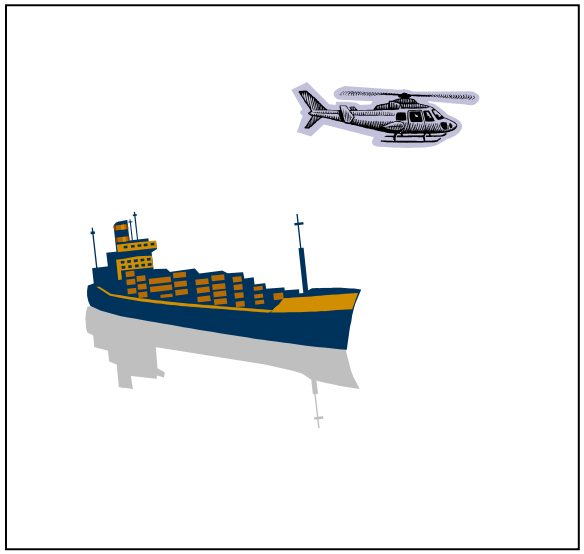
Alternative 2




- 3 Man Sea Marshal Team
- 12 Man Helo Transported Re-Take Team

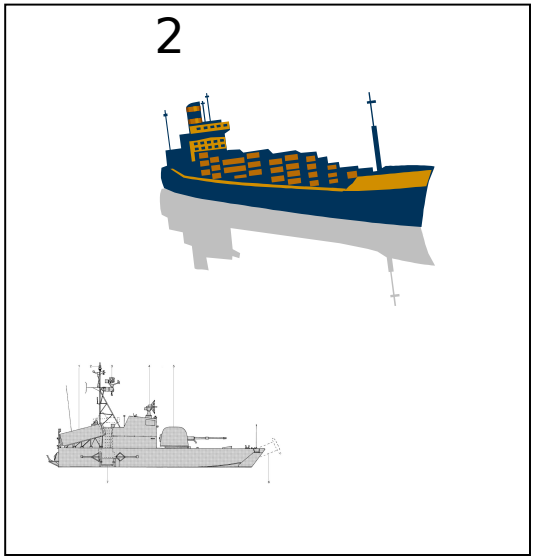
# Force WMD Scenario Alternatives

Alternative 1



- Helicopter Transports 12 Man Inspection Team from Singapore

Alternative 2



- Sparviero Patrol Craft Transports 12 Man Inspection Team

# Weapons Track TDSI

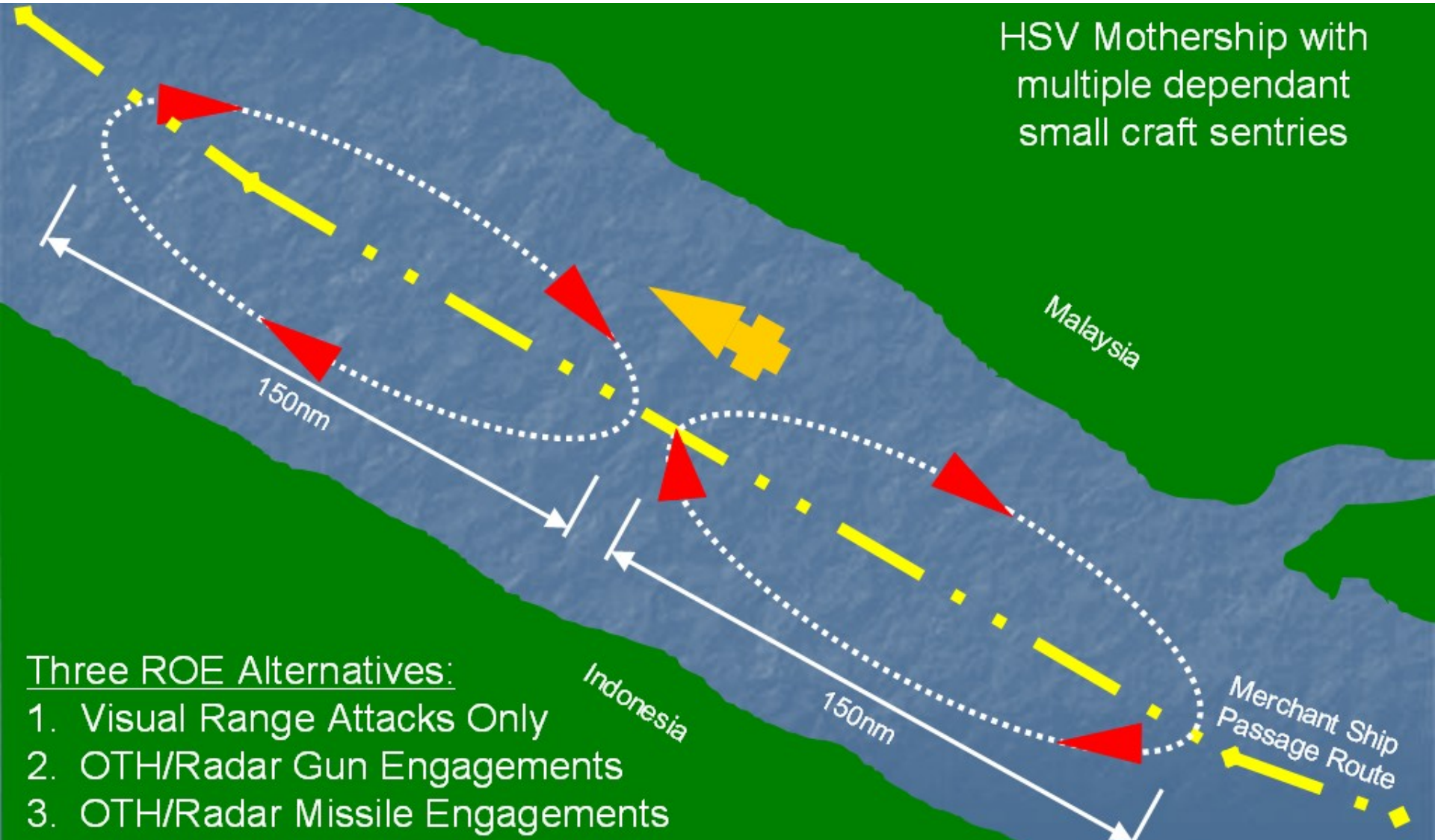
Presented by: LT John Lukacs

# Weapons Track Focus

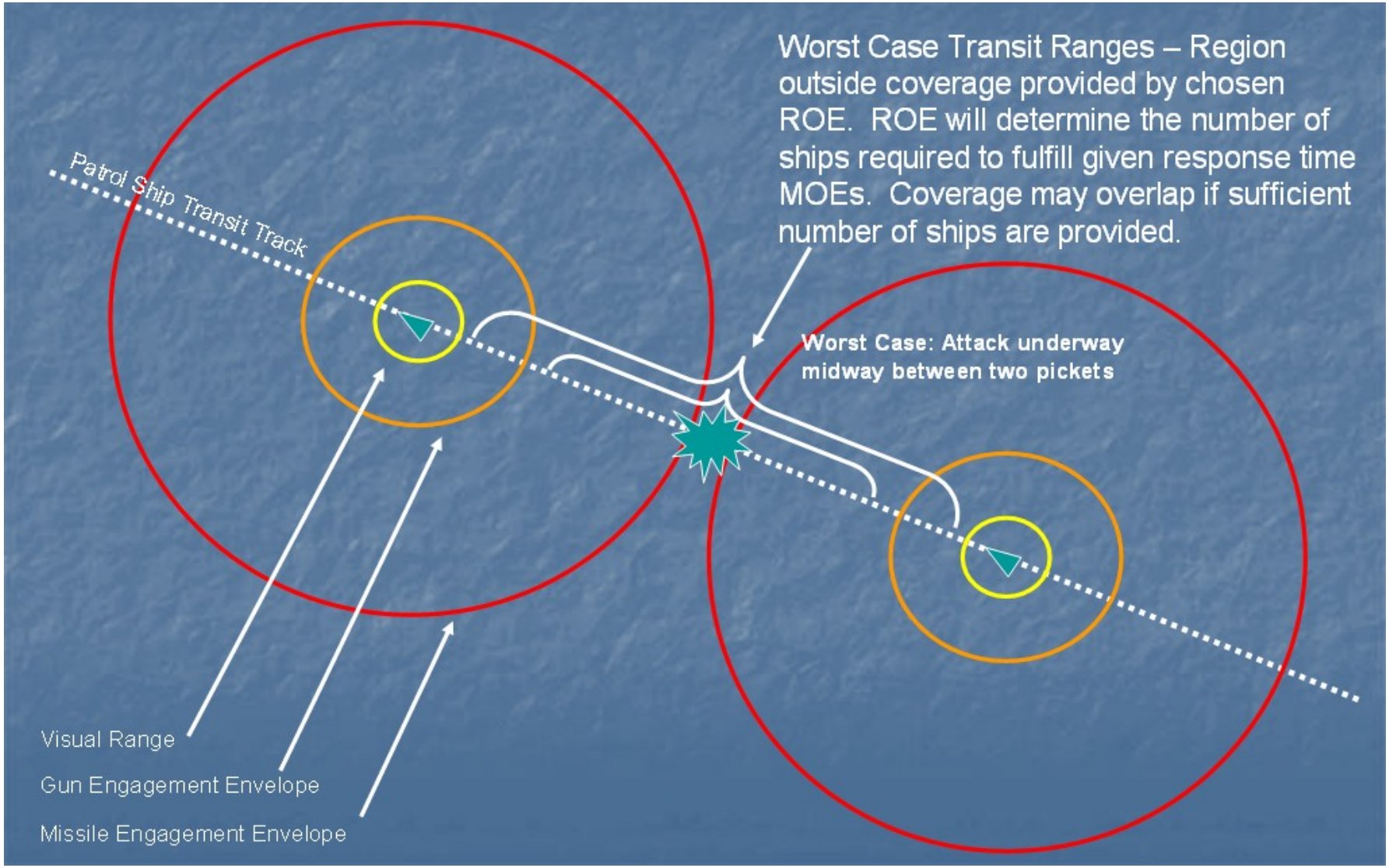
- Small Boat Attack
  - Minimal Response Time (2nm → 4 min.)
  - Maximum Precision Required (high traffic density)
  - High Durability Required (continuous operations)

- Ship As a Weapon / WMD Threat
  - Long Lead Time (Speed)
  - Moderate Durability Requirement (Range)
  - Transport WMD Inspection Team to target vessel

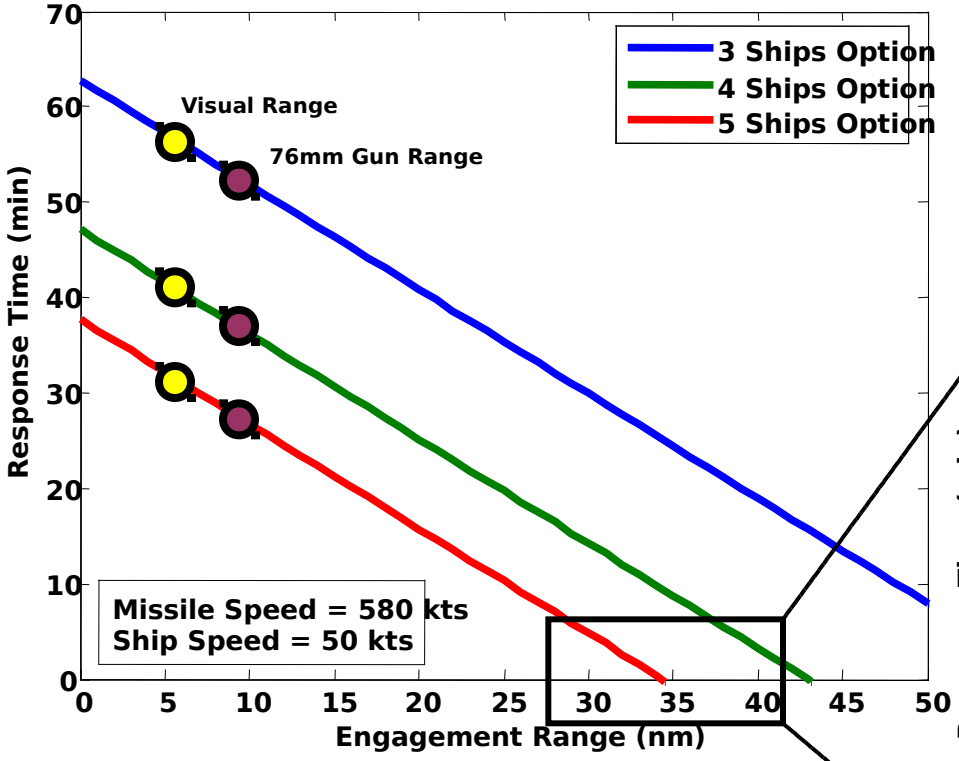
# Planned Operations



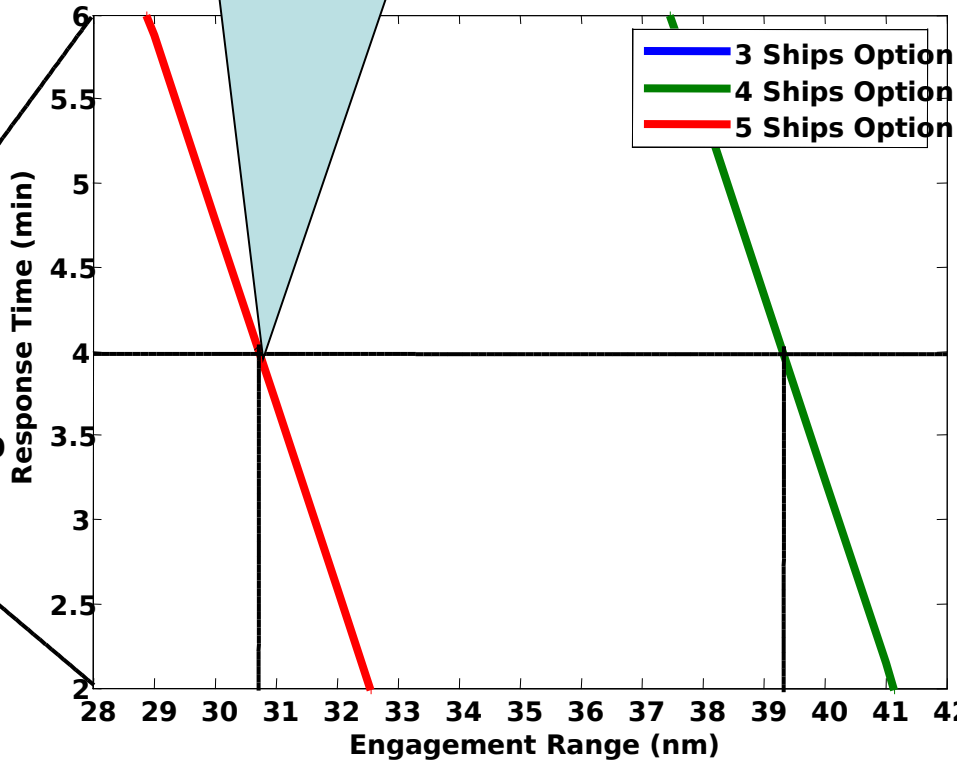
# Weapon Range Evaluation



# Numerical Requirements




Need 31nm Missile for Engagement Times < 4 minutes with 5 ship patrol

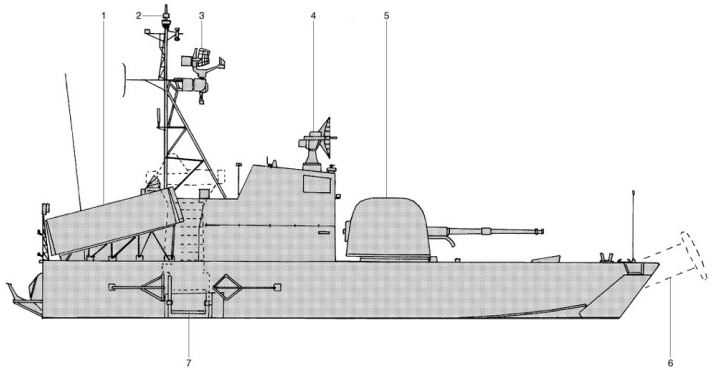


# Proposed Ships

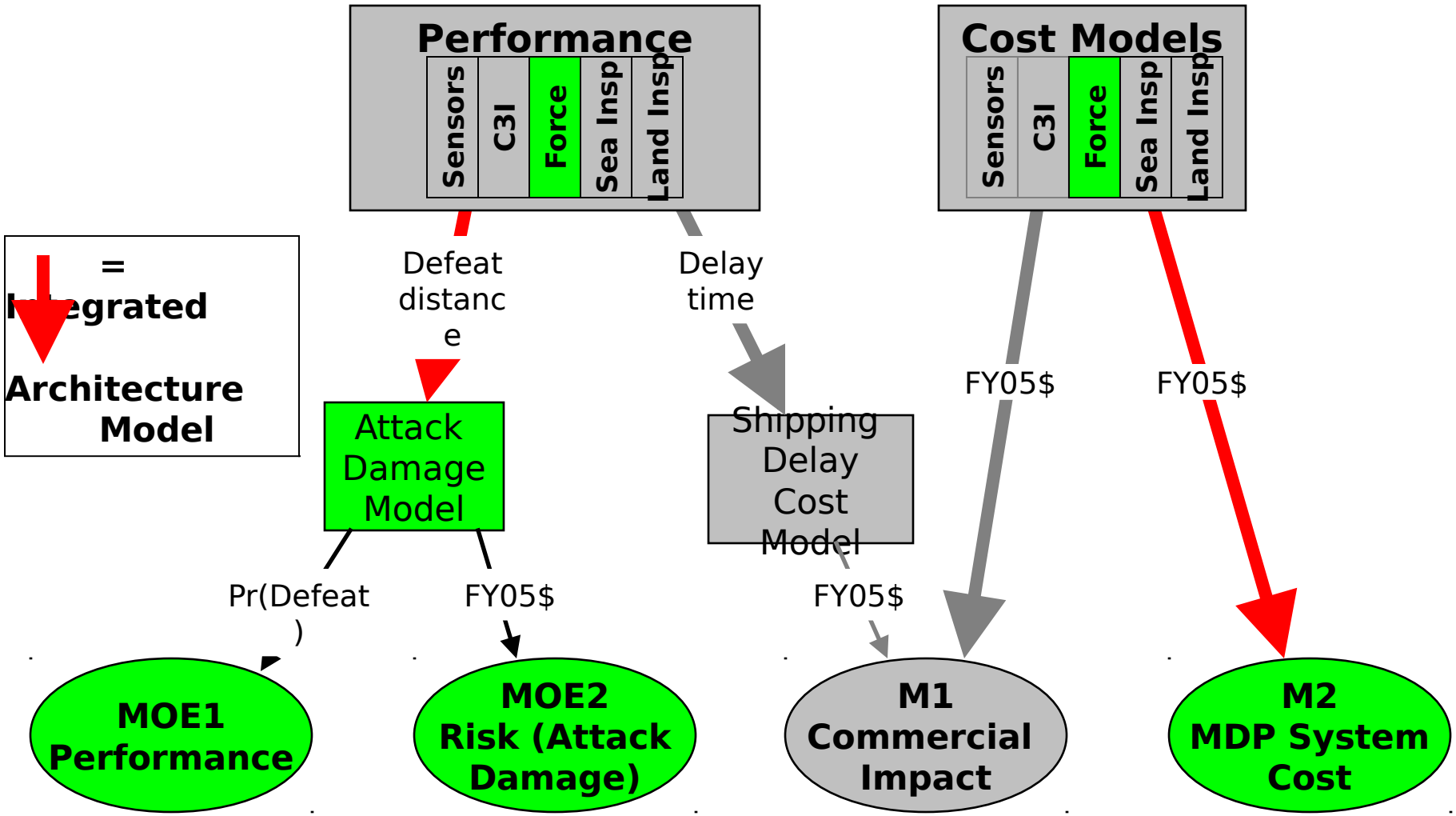
| | Tenix Fast Attack Craft | Hayabusa Class | Skjold Class | Sparviero Class |
|---|---|---|---|---|
| **Build** | **Monohull** | **Monohull** | **Catamaran** | **Hydrofoil** |
| **Length by Beam, ft** | **151 by 28** | **164 by 28** | **155 by 44** | **71.5 by 23** |
| **Speed, knots** | **34** | **44** | **45** | **46** |
| **Range, nm** | **2000 at 15 knots** | **Estimated 800** | **800** | **1200 at 8 knots** |
| **Displacement, tons** | **205** | **200** | **270** | **50** |
| **Compliment** | **37** | **21** | **15** | **11** |


# Selected Ship Type

- Sparviero Hydrofoil (Japan, Italy)
  - Range: 1200 nm
  - Speed: 46 kts
  - Displacement: 50 LT
  - Crew: 11 standard
  - Weapons:
    - 76mm deck gun
    - Otomat Mk 2 SSM
    - Interchangeable
  - Cost: $2.3 Million (est.)



# Force Modeling Plan



# 3 Force Models Used: Optimized by Scenario

- SBA
  - Map Aware Non-uniform Automata (MANA)
  - A multiagent-based simulation of notional combat
  - Patterned after mobile cellular automata rules
- SAW
  - EXTEND
- WMD
  - Microsoft EXCEL (Transport time only)

# OR Track TDSI

Presented by: Mr. Victor Ang

# Map-Aware Non-uniform Automata (MANA)

- Why MANA?
  - An entity based model
  - Designed to allow for the testing of robustness of observations across modeling platforms
  - Distillation model
    - Transparency
    - Speed
    - Little training needed
    - Ease of configurability
  - Light-weight model: permit examination of very wide range of possibilities and outcomes

# Data Analysis

- Design Model
  - Full factorial design of experiment
- Software Tool
  - Microsoft Excel
  - JMP Statistical Discovery software package
    - friendly graphical user interfaces
    - superb power to handle up to hundreds of thousands data points

# Patrol Scenario: Snap Shots of MANA Simulation

a) Initial Patrol Scenario

- 1 Small Boat, 7 HVUs, 3 TDSI Patrols and 68 Fishing Boats.

# Force Factors Considered

- Scenario Geography
- Engagement Range
- Weather
- Blue Force Starting Position
- Red Force Starting Position
- Pk
- # of Hostiles
- Transportation Speed
- Engagement rates
- Blue Force #s

RED : Factors varied

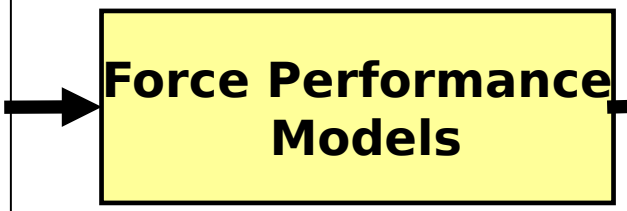
# Force Modeling Assumptions

- Sea Marshals are onboard before SBA attack commences
- One small boat only per SBA (No “Wolf pack” tactics)
- No $P_{fa}$ (Hostile intent is known with certainty)
- Max SAW Engagement Range will be defined by Singapore Port Limits
- Sea Marshals are conducting compliant boardings only
- All targets designated will be within range of response force sensors
- Effect of sea state is not modeled
- RAM data constant

# Force Performance Model Overview

## Input Variables

- Engagement range
- Blue Force Start Position
- Red Force Start Position
- $P_k$
- Force Engagement Rate
- # of Blue Force Agents
- # of Hostile Agents



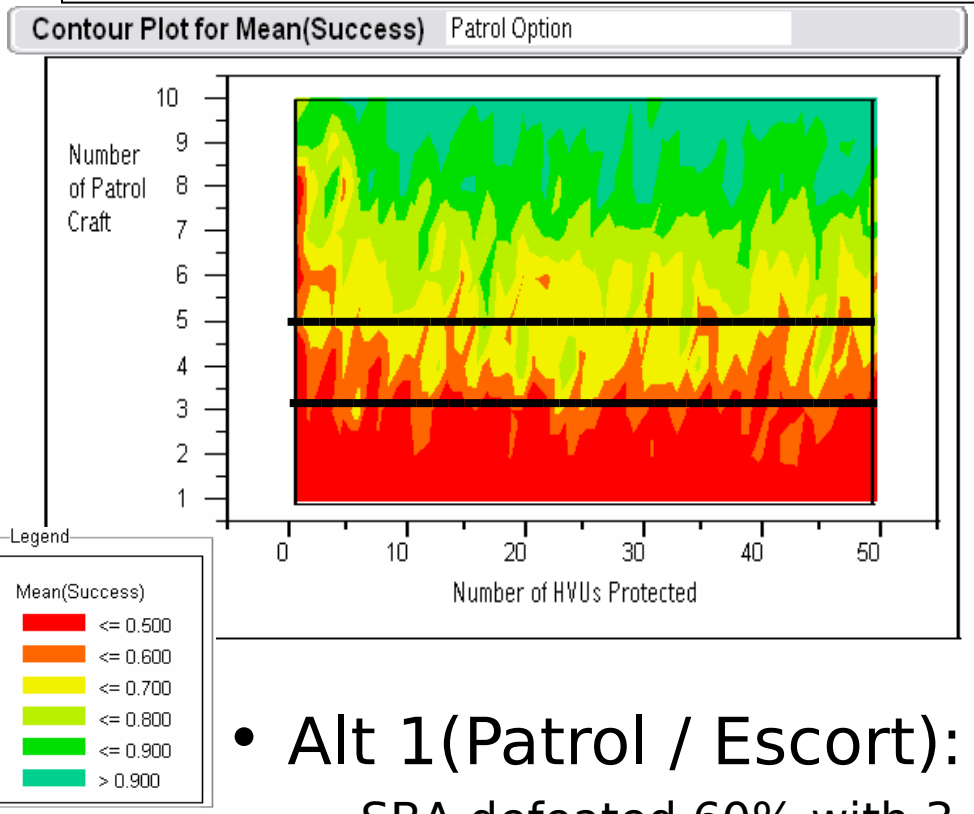

## Outputs

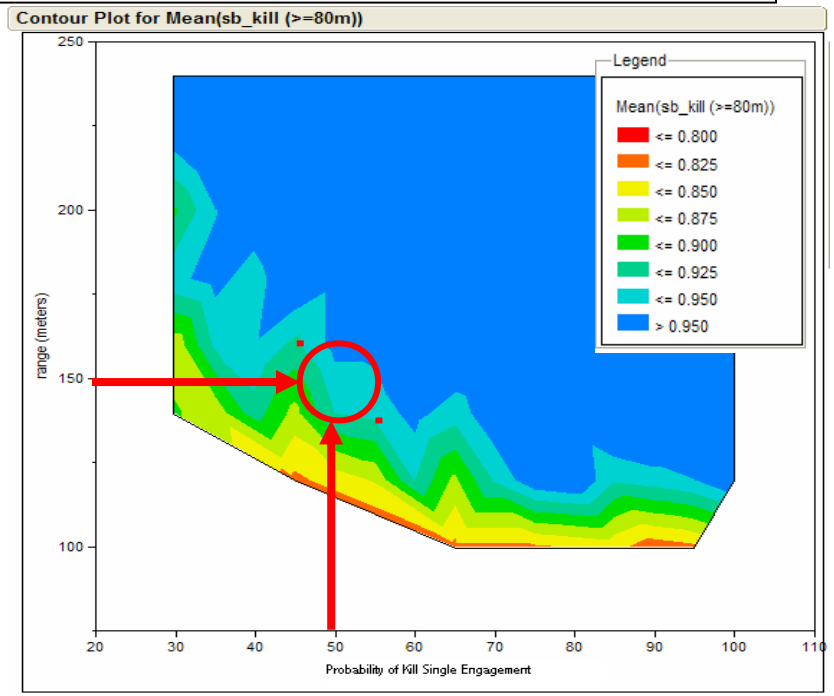
- $P_{DEF}$
- Transport Time

# Force Factor Parameters

| Scenario | Factor | As-Is | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
| SBA | Engagement Range | 0 Meters | 9 nm | 150 Meters |
| | $P_k$ | 0 | 80% | 50% |
| SAW | Engagement Range | 0-5nm | 0-5nm | 0-5nm |
| | Force Engagement Rate | 2.2 | 2.2 | 2.2 |
| | $P_k$ | 0 | 5-50% by Range | 50-95% by Range |

# Force SBA Model Results




- Alt 1(Patrol / Escort):
  - SBA defeated 60% with 3 Patrol Craft (70% with 5)
  - SBA defeated >90% with 3 Escort Craft protecting Convoy of HVUs
- Alt 2 (Sea Marshal):
  - SBA Defeated >92.5% with $P_{KSE}$ 50% if engaged at 150m
  - SBA Defeated >95% with $P_{KSE}$ 35% if engaged at 200m

# Force SAW Model Results

- As-Is (Sea Marshal):
  - 83% ± 2% Retake rate using Sea Marshals
- Alternative 1 (Patrol):
  - 91% ± 1% Retake rate using Sea Marshals and Patrol Craft with 2.5nm or more notification
  - Outside 2.5nm notification = no change in performance
- Alternative 2 (Helo):
  - 83% ± 2% Retake rate using Sea Marshals and Helicopter team (Helo ineffective inside 7nm notification)
  - Expected to be more effective when Helo has time to intercept

# Force WMD Model Results

- As-Is System
  - No response capability
- Alternative 1 (Helo)
  - 1.5 hours to lift inspection team to 250nm from Singapore
- Alternative 2 (Ship)
  - 1.5 hours to transport inspection team from forward land bases

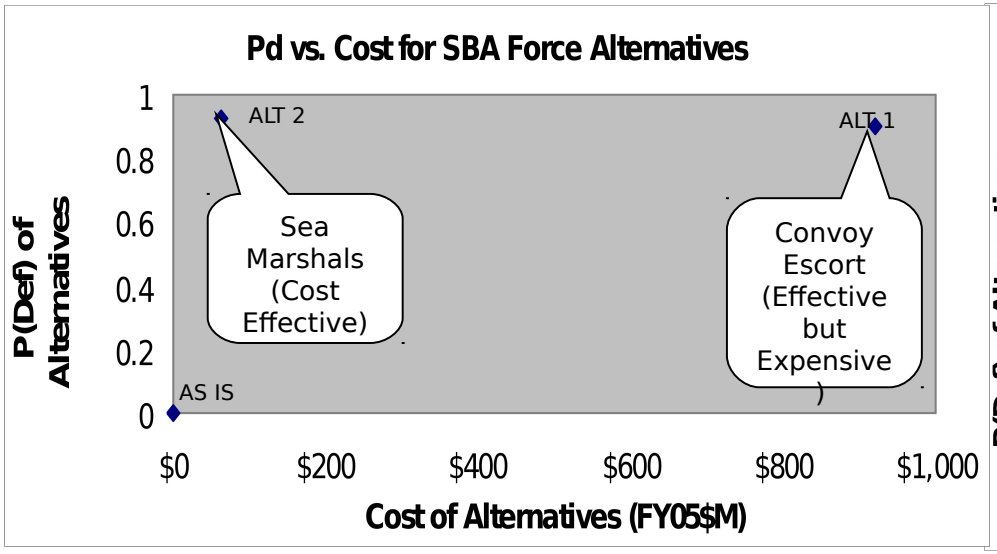
# Force Modeling Factors

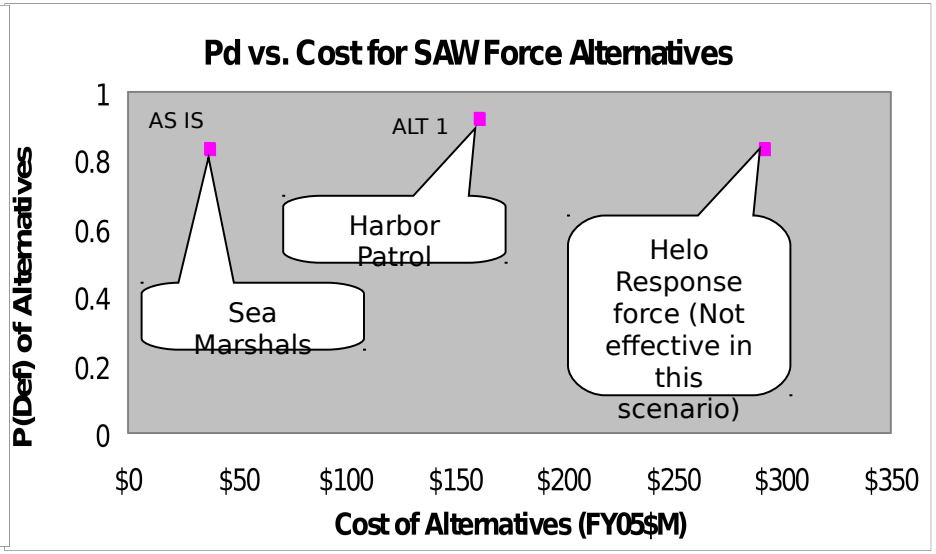
| | | Values Chosen | | |
|---|---|---|---|---|
| **Treatment** | **Values Evaluated** | **As-Is** | **Alt 1** | **Alt 2** |
| SBA $P_{KSE}$ | 0.3 - 1.0 | 0 | 0.8 | 0.5 |
| SBA Engage Range | 100m - 50nm | 0 | 50nm or 9nm | 150m |
| SAW Sea Marshal FER | 1.5, 2.0, 2.2, 2.5 | 2.2 | 2.2 | 2.2 |
| SAW Engage Range | .5nm - 5nm | 5 | 5 | 5 |
| SAW Engage $P_k$ | .5-.05 | 0 | .25-.5 | .5-.95 |
| WMD Inspection Team Transport Speed | 150kts , 46kts | 0 | 150kts | 46kts |

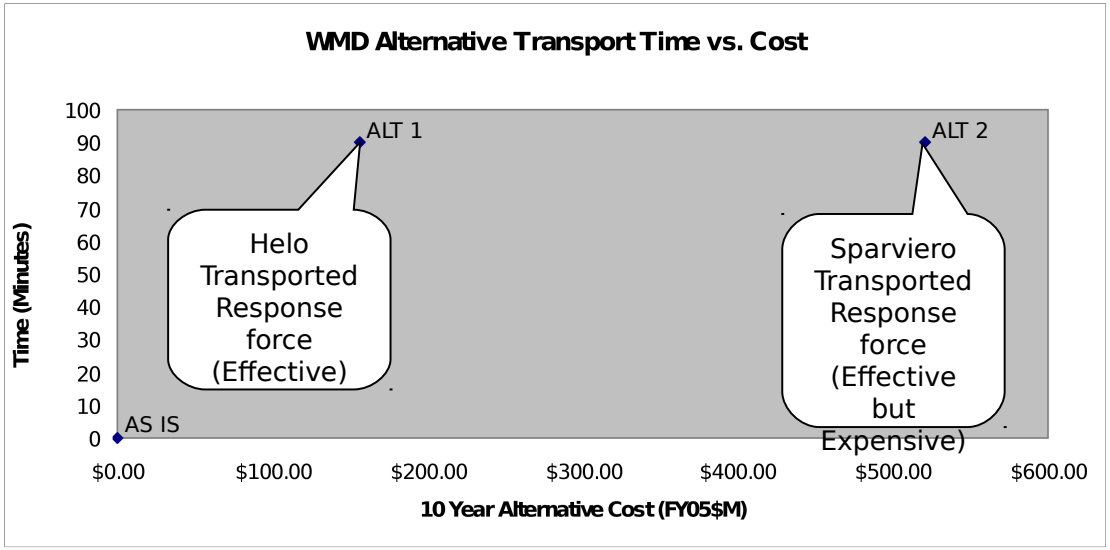
# Force System Results

| MOE's | 'As-Is' | ALT 1 | ALT 2 |
|---|---|---|---|
| P(Defeat) SBA | 0% | 90% | 95% |
| P(Defeat) SAW | 83% | 92% | 83% |
| Time To Transport WMD | 0 | 1.5 Hr | 1.5 Hr |
| System Cost for SBA (FY05$M) | $0 | $921 | $63 |
| System Cost for SAW (FY05$M) | $38 | $292 | $162 |
| System Cost for WMD (FY05$M) | $0 | $157 | $521 |

# Force Cost vs. Performance Results



# Force Conclusions/Insights

SBA

- Best countered by onboard Sea Marshals with crew served weapons
- Escort of HVU Convoy produced marked improvements over patrolling

SAW

- Inport threat best countered by combination Sea Marshal / Patrol Craft
- Helicopter response force (STAR-like) shows promise if attack is detected early

WMD

- Transport inspection team by helicopter from Singapore

# Questions?

- Force Group
  - LT DJ Walton, USN
  - LT Enrique Garcia, MxN
  - ENS Cory MacCumbee, USN
- Operations Analysis Track TDSI Group
  - Mr. Han Hiong Ang, SGP
  - Mr. Lawrence Liang, SGP
- Weapons Tack TDSI Group
  - Mr. Kim Hua Er, SGP
  - LT John Lukacs, USN
  - Mr. Chin Khoon Quek, SGP
  - Mr. Dinesh Raghavan, SGP
  - Mr. Yew Seng How, SGP

# Backup Slides

# Numerical Requirements

| Number of Ships | Visual Range | | | |
|---|---|---|---|---|
| | Worst Case Range (nm) | Response Time at 30kts (min) | Response Time at 40kts (min) | Response Time at 50kts (min) |
| 3 | 47.10 | 94.21 | 70.66 | 56.52 |
| 4 | 34.02 | 68.04 | 51.03 | 40.82 |
| 5 | 26.17 | 52.34 | 39.26 | 31.40 |
| 13 | 6.85 | 13.69 | 10.27 | 8.22 |
| 14 | 5.98 | 11.97 | 8.98 | 7.18 |
| 15 | 5.24 | 10.47 | 7.86 | 6.28 |
| 16 | 4.58 | 9.17 | 6.87 | 5.50 |
| 17 | 4.01 | 8.01 | 6.01 | 4.81 |
| 18 | 3.49 | 6.98 | 5.24 | 4.19 |
| 19 | 3.03 | 6.07 | 4.55 | 3.64 |
| 20 | 2.62 | 5.24 | 3.93 | 3.14 |
| 21 | 2.25 | 4.49 | 3.37 | 2.70 |
| 22 | 1.91 | 3.81 | 2.86 | 2.29 |
| 23 | 1.60 | 3.19 | 2.39 | 1.92 |
| 24 | 1.31 | 2.62 | 1.97 | 1.57 |
| 25 | 1.05 | 2.10 | 1.58 | 1.26 |

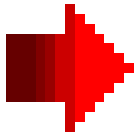
| 76mm (9nm) - Flight Time at 960 kts = 0.25 | | | |
|---|---|---|---|
| Worst Case Range (nm) | Response Time at 30kts (min) | Response Time at 40kts (min) | Response Time at 50kts (min) |
| 43.33 | 86.92 | 65.25 | 52.25 |
| 30.25 | 60.75 | 45.63 | 36.55 |
| 22.40 | 45.05 | 33.85 | 27.13 |
| 3.08 | 6.40 | 4.87 | 3.94 |
| 2.21 | 4.68 | 3.57 | 2.91 |
| 1.47 | 3.18 | 2.45 | 2.01 |
| 0.81 | 1.88 | 1.47 | 1.23 |
| 0.24 | 0.72 | 0.60 | 0.53 |

| Number of Ships | Missile (30nm) - Flight Time at 580kts = 3.1 | | | |
|---|---|---|---|---|
| | Worst Case Range (nm) | Response Time at 30kts (min) | Response Time at 40kts (min) | Response Time at 50kts (min) |
| 3 | 22.33 | 44.67 | 33.50 | 26.80 |
| 4 | 9.25 | 18.50 | 13.88 | 11.10 |
| 5 | 1.40 | 2.80 | 2.10 | 1.68 |

| Missile (50nm) - Flight Time at 580kts = 5.2 | | | |
|---|---|---|---|
| Worst Case Range (nm) | Response Time at 30kts (min) | Response Time at 40kts (min) | Response Time at 50kts (min) |
| 2.33 | 4.67 | 3.50 | 2.80 |

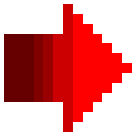
# Project Albert

- Developed by U.S.M.C. Warfighting Laboratory
- R&D effort to develop the process and capabilities of Data Farming
- A suite of entity based models
- Designed to allow for the testing of robustness of observations across modeling platforms
- Includes MANA, Socrates, and Pythagoras models



# ISAAC/EINSTein

- A multiagent-based simulation of notional combat whose dynamics is patterned after mobile cellular automata rules
- Designed for identifying, exploring, and possibly exploiting emergent collective patterns of behavior on the battlefield.



# MANA Model Assumptions

- Sea Marshals are onboard before SBA attack commences
- One small boat only per SBA (No “Wolf pack” tactics)
- No $P_{fa}$ (SBA intent is known with certainty)
- All targets designated will be within sensor range
- Over the Horizon Missile use will be allowed for TDSI Alternative
- RAM data constant
- Effect of sea state is not modeled

# EXTEND Model Assumptions

- No $P_{fa}$
- Sea Marshals are conducting compliant boardings only
- Max Engagement Range will be defined by Singapore Port Limits
- All targets designated will be within range of response force sensors
- RAM data constant